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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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DICKSTEIN SHAPIRO MORIN & OSHINSKY LLP
2101 L STREET NW
WASHINGTON, DC 20037-1526

EXAMINER

NGUYEN, HA T

ART UNIT	PAPER NUMBER
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2812

DATE MAILED: 01/14/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/653,561

Applicant(s)

HILLYER ET AL.

Examiner

Ha T. Nguyen

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE _____ MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☐ Responsive to communication(s) filed on _____.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-4, 6-18, 20-31, 34-39, 41-44, 50, and 52-97 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☒ Claim(s) 16-18, 20-24, 27-31, 34-39, 41-44 and 86-91 is/are allowed.
- 6) ☒ Claim(s) 1-4, 6-15, 25, 26, 50, 52-85 and 92-97 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. §§ 119 and 120

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
* See the attached detailed Office action for a list of the certified copies not received.
- 13) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application) since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.
a) ☐ The translation of the foreign language provisional application has been received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121 since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.

Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892) 4) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948) 5) ☐ Notice of Informal Patent Application (PTO-152)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ 6) ☐ Other: _____

DETAILED ACTION

Notice to applicant

1. Applicants' Amendment and Response to the Office Action mailed 02-12-03 and Request for a Continued Examination have been entered and made of record (Paper Nos. 13 and 16).

Following is an Office Action responding to the request.

Response to Amendment

2. In view of Applicants' arguments and the amendment to the claims, the rejections of claims 16-18, 20-24, 27, 28-31, 34-39, 41-44, and 86-91 under 35 U.S.C. 103, as stated in the Office Action mailed 02-12-03, have been withdrawn.

Applicants' arguments with regard to the rejections under 35 U.S.C. 102 or 103 of the remaining claims have been fully considered, but they are not deemed to be persuasive for at least the following reasons.

Applicants' main argument is that Smith does not teach removing etch residues using a plasma consisting of ammonia, hydrogen, or methane. The examiner disagreed, Smith discloses the use of plasma of hydrogen, ammonia, or methane alone or in combination with other gases to remove photoresist and etch residues (see col. 3, lines 36-55). The case where the plasma used is formed by only one hydrogen containing gas (ammonia, hydrogen, or methane) the "consisting" limitation is met. Note that even though, in Smith a clean-up step using a hydrogen containing gas and a fluorocarbon can be performed, it is not necessary (see col. 3, lines 54-55). Therefore, Smith does teach the use of a plasma consisting of ammonia, hydrogen, or methane.

Claim Rejections - 35 USC § 102

3. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless --

(e) the invention was described in a patent granted on an application for patent by another filed in the United States before the invention thereof by the applicant for patent, or on an international application by another who has fulfilled the requirements of paragraphs (1), (2), and (4) of section 371[©] of this title before the invention thereof by the applicant for patent.

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4. Claims 1-4, 14, 54-57, 66, 70-73, and 82 are rejected under 35 U.S.C. 102(e) as being unpatentable by Smith (U. S. Patent 6277733).

[Claims 1, 54, and 70] Referring to Figs. 1, 2a-2h and related text, Smith discloses a method for removing polymer etch residue from an etched opening in a semiconductor wafer device comprising: forming an opening 429 in an insulating layer, wherein a polymer etch residue remains within said opening after the opening forming step (see Fig. 2d and col. 4, lines 8-26); contacting said opening with a plasma to remove said polymer etch residue, said plasma generated from a gas consisting of ammonia, H₂, or CH₄ (see col. 4, lines 8-26); the examiner interprets that inherently some residues are also removed;

[Claims 2, 55, and 71] wherein said opening is a HAR contact opening (see Fig. 2f);

[Claims 3, 56, and 72] wherein said contacting is performed under conditions effective to remove said etch residue without substantially increasing the size of said opening (See col. 1, 54-56);

[Claims 4, 57, and 73] wherein said opening is contacted with ammonia, H₂, or CH₄ gas in the absence of oxygen (See col. 4, lines 8-48);

[Claims 14, 66, and 82] further comprising forming a conductive layer at the bottom of said opening following said contacting step (see col. 5, lines 33-42).

Claim Rejections - 35 USC §103

5. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was

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made in order for the examiner to consider the applicability of 35 U.S.C. 103[®] and potential 35 U.S.C. 102(f) or (g) prior art under 35 U.S.C. 103(a).

6. Claims 6-13, 58-65, and 74-81 are rejected under 35 U.S.C. 103(a) as being unpatentable over Smith.

Smith discloses substantially the limitations of claims 6-13, 58-65, and 74-81, as shown above. [Claims 6, 58, and 74] It also discloses wherein said contacting is done at a temperature within the range of about 250-500C (See col. 4, lines 33-43).

But Smith does not disclose the parameters for the ammonia, H₂, or CH₄ plasma contacting step. However any variation in parameters in the present claims is obvious in light of the cited art, because the changes in parameters produce no unexpected function.

The routine varying of parameters to produce expected changes are within the ability of one of ordinary skill in the art. Patentability over the prior art will only occur if the parameter variation produces an unexpected result. In re Aller, Lacey and Hall, 105 U.S.P.Q. 233, 235. In re Reese 129 U.S.P.Q. 402, 406.

Therefore, it would have been obvious to use the teaching of Smith to obtain the invention as specified in claims 6-13, 58-65, and 74-81.

7. Claims 1, 2, 15, 25, 26, 50, 52-53, 67-69, 83-85, and 92-97 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kawai in view of Smith and Hamada.

[Claims 1, 2, 15, 25, 26, 50, 53, 67-69, 83-85, 92, 94, 95, and 97] Referring to Figs. 3A-3D, Kawai discloses a method of forming an integrated circuit structure comprising: forming an insulating layer 18 over a polysilicon region 14; forming a contact opening in said insulating layer down to said polysilicon region using a fluorine containing gas (see col. 4, lines 4-18); removing polymer residue from said contact opening using a gas (see col. 4, lines 26-58). But it does not disclose that the contact opening has HAR, the steps of removing polymer residue with plasma essentially of ammonia, hydrogen, or methane gas, forming a titanium silicide at the bottom of said opening in contact with said polysilicon layer; forming a conductor in said opening in electrical contact with said silicide; and using said gas to remove polymer residue after using oxygen plasma; wherein said second plasma contacting is performed for a period of

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time sufficient to remove said residue from a bottom of said opening ; wherein said bottom of said opening is not oxidized during said second plasma contacting, and said contact does not substantially increase the size of the opening. However, the missing limitations are well known in the art because Smith discloses substantially all the missing limitations as shown above; wherein said second plasma contacting is performed for a period of time sufficient to remove said residue from a bottom of said opening (see col. 4, lines 8-48); wherein said bottom of said opening is not oxidized during said second plasma contacting step (see col. 4, lines 8-48); and Hamada discloses forming a titanium silicide 111 at the bottom of said opening in contact with said polysilicon layer 104; forming a conductor 112 in said opening in electrical contact with said silicide (see Fig. 3D and col. 5, lines 1-20);.

[Claims 52, 93, and 96] further comprising removing a portion of said polymer residue from said contact opening with oxygen;

A person of ordinary skill is motivated to modify Kawai with Smith and Hamada to obtain good-cleaning and improved connection conductivity.

Therefore, it would have been obvious to combine Kawai with Smith and Hamada to obtain the invention as specified in claims 1, 2, 15, 25, 26, 50, 52-53, 67-69, 83-85, and 92-97.

Allowable Subject Matter

8. Claims 16-18, 20-24, 27-31, 34-39, 41-44, and 86-91 are allowed.

Claim 16 recites “contacting said opening with a plasma consisting oxygen of to remove a portion of said etch residue, stopping said oxygen plasma contacting before said polymer etch residue is completely removed and thereafter removing any remaining said residue by contacting said opening with a second plasma, said second plasma consisting of a hydrogen containing gas” and claim 29, “contacting said opening with an oxygen plasma to remove a portion of said etch residue and removing any remaining etch residue from said etched opening by contacting said opening with a plasma consisting of a hydrogen containing gas in the absence of added oxygen” .

These features in combination with the other elements of the claims are neither disclosed nor suggested by the prior art of record.

Claims 17-18, 20-24, 27-28, 30-31, 34-39, 41-44, and 86-91 variously depend from claim 16 or 29, they are allowed for the same reason.

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Conclusion

9. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Ha Nguyen whose telephone number is (703) 308-2706 , after Feb. 3, 2004, the new phone number will be (703) 272-1678. The examiner can normally be reached on Monday-Friday from 8:30AM to 6:00PM, except the first Friday of each bi-week. The telephone number for Wednesday is (703) 560-0528.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, John Neibling, can be reached on (703) 308-3325, after Feb. 3, 2004, the new phone number will be (703) 272-1679. The fax phone number for this Group is (703) 872-9306.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the Group receptionist whose telephone number is (703) 308-0956.



Ha Nguyen

Primary Examiner

01- 9- 04